

UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
OFFICE OF NUCLEAR REACTOR REGULATION  
WASHINGTON, D.C. 20555

October 31, 1990

NRC INFORMATION NOTICE NO. 90-69: ADEQUACY OF EMERGENCY AND ESSENTIAL LIGHTING

Addressees:

All holders of operating licenses or construction permits for nuclear power reactors.

Purpose:

This information notice is intended to alert addressees to a possible problem concerning the adequacy of emergency and essential lighting at commercial power reactor facilities. It is expected that recipients will review the information for applicability to their facilities and consider actions, as appropriate, to avoid similar problems. However, suggestions contained in this information notice do not constitute NRC requirements; therefore, no specific action or written response is required.

Description of Circumstances:

On March 3, 1989, Unit 3 at the Palo Verde Nuclear Generating Station experienced a reactor/turbine trip, main steam isolation, containment isolation, and safety injection as a result of a grid-induced load rejection event. This event included three significant system failures: (1) half of the steam bypass control system malfunctioned; (2) the atmospheric dump valves (ADV) failed to operate from the control room and the remote shutdown panel; and (3) the emergency lighting in the main steam support structure (MSSS) failed, hampering the operators in their attempt to cope with the ADV failures. Being unable to maintain pressure control on the secondary side by operating the ADVs from the control room or the remote shutdown panel, plant personnel attempted to establish local (manual) control of the ADVs in the MSSS. When operators first entered the MSSS, they found no direct lighting. Normal lighting was lost due to the loss of power to the non-Class 1E electrical busses in the plant. The emergency lighting was not properly positioned in the north MSSS room (containing the ADVs for the No. 1 steam generator) to provide adequate lighting for the operators to perform their required activities and was not functioning at all in the south MSSS room (containing ADVs for the No. 2 steam generator). Because of a burned-out light bulb, plant personnel could not restore essential lighting (from Class 1E power sources) in the south MSSS room.

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During the NRC inspection (50-530/89-13) conducted by an augmented inspection team (AIT) sent to examine the event at Palo Verde, the staff found deficiencies in the licensee's maintenance and testing of emergency and essential lighting. The team discovered that plant personnel had waived the quarterly preventive maintenance (PM) tasks on the MSSS emergency and essential lights for five consecutive quarters. By grouping the lights in the MSSS with the lights in the containment building, which were inaccessible during power operations, the PM tasks were waived for the MSSS lights during each of these periods along with the containment lights. NRC inspections further revealed that the licensee, prior to the performance of the 8-hour lighting unit discharge test, performed preventive maintenance (i.e., battery replacement, addition of electrolyte, cleaning of battery terminals, and battery charging) on the lighting unit battery. This preventive maintenance practice resulted in not verifying the performance of the 8-hour emergency lighting units in the "as found" condition. The inspections also revealed that the licensee had failed to implement the relevant portions of its quality assurance program for emergency lighting. Because of these failures, the emergency lighting was not properly tested, and deficiencies were not properly corrected.

After the event, plant personnel reconstructed the design bases of the lighting system and conducted walkdown inspections of the emergency and essential lighting in the plant. In some instances, the licensee found the lighting to be inadequate to perform the required tasks because the original design did not require emergency lights or because the emergency lights provided inadequate illumination. In addition, the licensee identified many areas that required the installation of or modification to lighting to meet the licensee's design bases and the requirements in 10 CFR Part 50 Appendix R.

#### Background:

At Palo Verde, the essential lighting system is an integral part of the normal lighting system that provides illumination if the normal lighting system fails. The essential lighting system is rated non-Class 1E but is powered from Class 1E sources. The system provides lighting in the control room, in the shutdown panel area, in the main walkways and stairs, in the Class 1E switchgear rooms, in areas having Class 1E equipment, and in areas used for the safe shutdown of the reactor. Upon loss of the normal lighting system, the essential lighting system provides adequate illumination for the safe shutdown of the reactor. The system receives power from two redundant and independent Class 1E ac busses. Each redundant Class 1E ac bus supplies power to 50 percent of the essential lighting in the vital areas. The diesel generators provide backup power.

The emergency lighting system receives dc power from two redundant Class 1E batteries through inverters and provides illumination for the control room, the auxiliary electrical equipment rooms, the stairways, and the points leading to plant exits. The system is normally deenergized and is automatically energized upon loss of ac power to the normal system. The emergency lighting system is also composed of 8-hour and 1½-hour (individually battery-powered) emergency lighting units. The 8-hour emergency lighting units are designed to meet the technical requirements of 10 CFR 50 Appendix R, Section III.J which requires that emergency lighting units with at least an 8-hour battery power supply be provided in all areas needed for operation of safe shutdown equipment and in access and egress routes thereto. The 1½-hour emergency lighting units are installed to meet the requirements of the Life Safety Code. These lighting units are generally installed in plant locations to accommodate the safe evacuation of personnel in the event of a fire in such areas.

#### Discussion:

During the Palo Verde event, the inadequate lighting conditions significantly complicated the licensee's efforts to cope with the initial failure of the ADVs, which delayed the commencement of the controlled removal of decay heat as called for by the emergency operating procedures.

It is important to note that adequate PM and routine testing programs for essential and emergency lighting systems are helpful in ensuring adequate illumination for the operation of safe shutdown equipment. Emergency lighting is a key fire protection feature associated with supporting post-fire safe shutdown operations. The exercise of good engineering design practices that conform to industry standards ensures the ability of the lighting system to provide adequate station lighting in all vital areas during all types of accident or transient conditions. The implementation of an effective PM and testing program which demonstrates lighting system operability is important. Emergency lighting PM programs recommended by manufacturers generally include routine monitoring of the battery condition for each lighting unit, periodic load testing to verify that the lighting unit and its associated charger are functioning properly, and a periodic "as found" 8-hour lighting unit discharge test. In addition, the Palo Verde event identified that the inadvertent repositioning of the emergency lighting fixtures can cause inadequate illumination and that routine verification of emergency lighting fixture orientation can ensure that emergency lighting is effective.

This information notice requires no specific action or written response. If you have any questions about the information in this notice, please contact one of the technical contacts listed below or the appropriate NRR project manager.

  
Charles E. Rossi, Director  
Division of Operational Events Assessment  
Office of Nuclear Reactor Regulation

Technical Contacts: N. K. Trehan, NRR  
(301) 492-0777

S. R. Peterson, NRR  
(301) 492-3062

Attachment: List of Recently Issued NRC Information Notices

LIST OF RECENTLY ISSUED  
NRC INFORMATION NOTICES

Information Notice No.	Subject	Date of Issuance	Issued to
90-68	Stress Corrosion Cracking of Reactor Coolant Pump Bolts	10/30/90	All holders of OLs or CPs for pressurized water reactors (PWRs).
90-67	Potential Security Equipment Weaknesses	10/29/90	All holders of OLs or CPs for nuclear power reactors and Category I fuel facilities.
90-66	Incomplete Draining and Drying of Shipping Casks	10/25/90	All holders of OLs for nuclear power reactors and all registered users of NRC approved waste shipping packages.
88-63, Supp. 1	High Radiation Hazards From Irradiated Incore Detectors and Cables	10/5/90	All holders of OLs or CPs for nuclear power reactors.
90-65	Recent Orifice Plate Problems	10/5/90	All holders of OLs or CPs for nuclear power reactors.
90-64	Potential for Common-Mode Failure Of High Pressure Safety Injection Pumps or Release of Reactor Coolant Outside Containment During A Loss-Of-Coolant Accident	10/4/90	All holders of OLs or CPs for pressurized-water reactors.
90-63	Management Attention to the Establishment and Maintenance of A Nuclear Criticality Safety Program	10/3/90	All fuel cycle licensees possessing more than critical mass quantities of special nuclear material.

OL = Operating License  
CP = Construction Permit

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D/DOEA:NRR  
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\*CHBerlinger \*TechEd  
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OGCB:DOEA:NRR SELB:DST:NRR  
\*PCWen \*NKTrehan  
09/24/90 09/24/90

AD/AD45  
\*BABoger  
10/09/90

C/SELB:DST:NRR  
\*FRosa  
09/25/90

D/PD5  
\*JEDyer  
10/09/90

C/SPLB:DST:NRR  
\*CMcCracken  
10/03/90

PD5:DRSP:NRR  
\*SRPeterson  
09/24/90

D/DST:NRR  
\*ATHadani  
10/03/90

DOCUMENT NAME: IN 90-69

*Changes to the final draft  
of this information notice  
were discussed with C. Berlinger  
on 10/24/90 and N. Trehan on  
10/25/90. P.Wen and S. Peterson  
were not available to  
review the changes  
C.E. Rossi  
10/25/90*

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Document Name: INADQUATE LIGHTING

\*SEE PREVIOUS CONCURRENCES

D/DOEA:NRR

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C/OGCB:DOEA:NRR RPB:ADM

CHBerlinger TechEd

10/16/90 10/10/90

\*OGCB:DOEA:NRR \*SELB:DST:NRR

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09/24/90

NKTrehan

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CMcCracken

10/3/90

\*PD5:DRSP:NRR

SRPeterson

09/24/90

D/DSP:NRR 117

AThadani 10/3

10/3/90

Discussion:

During the Palo Verde event, the inadequate lighting conditions significantly complicated the licensee's efforts to cope with the initial ADVs failure. However, the plant personnel were eventually able to open two ADVs and, thereby, commence a controlled removal of decay heat as called for by the emergency operating procedures.

Other plants may also have inadequate PM programs for the emergency and the essential lighting systems and may provide inadequate illumination for the operation of safe shutdown equipment. This event also points out that the inadvertent repositioning of emergency lighting units can cause inadequate illumination. By verifying the orientation of these units, the licensees can ensure that the lights are positioned properly.

Emergency lighting is a key fire protection feature for the operation of the safe shutdown equipment. Appendix R to 10 CFR Part 50 requires 8-hour emergency lighting units in areas used for the operation of safe shutdown equipment and in access and egress routes thereto. The staff relies on the exercise of good engineering design practice and design criteria that conform to industry standards to ensure the ability of the lighting system to provide adequate station lighting in all vital areas during all types of accident or transient conditions and in the access routes to and from these areas.

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Document Name: INADQUATE LIGHTING

D/DOEA:NRR	C/OGCB:DOEA:NRR	RPB:ADM	AD/AD45	D/PD5
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09/ /90	09/ /90	09/ /90	09/ /90 9/25	09/ /90
OGCB:DOEA:NRR	SELB:DST:NRR	C/SELB:DST:NRR	D/DST:NRR 117	PD5:DRSP:NRR
PCWen PCW	NKTrehan 251	FRosatt 117	ATHadani	SRPeterson 251
09/24/90	09/24/90	09/25/90	09/ /90	09/24/90

C/SP3B: DST: NRR  
CE McCracken



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INADQUATE LIGHTING

**Requestor's ID:**  
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